

# A Study of Suburbanization Effects on Urban Spatial Structure(郊外化が都市空間構造に及ぼす影響に関する研究)

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## 論 文 内 容 要 旨

### Chapter 1 . Introduction

On the basis of a monocentric city model, this paper, through establishing two duocentric models, attempts to analyze the effects of the process of suburbanization on urban spatial structure and the behavior of each economic agent in the city.

Chapter 1 discusses two objective conditions of promoting the process of suburbanization (improvement of the transportation system and progresses in information systems) and three phenomena of suburbanization: satellite cities, subcenters and edge cities. The literature on these three phenomena is reviewed and they are compared through six features contributing to the purpose and agent of creation.

### Chapter 2 . Model of a Closed City with a Subcenter

Traditionally, for simplicity of analysis, research on subcenters usually assumes subcenter creation at a point far from the Central Business District (CBD) in a linear city; or at a circle road running around a CBD in two-dimensional models. However, neither is realistic.

Yinger [1992] first relaxed the assumption by introducing into an Alonso-type model the transportation system of Anas and Moses [1979]. A subcenter is assumed to be established at one point far from the CBD. According to subcenter location, four different urban configurations arise and the urban shape of each configuration is discussed in detail. However, the complexity of the transportation system combined with these urban configurations makes the model intractable.

Ross and Yinger [1995] improved upon the complex urban system of Yinger [1992] by constructing a more general model in that wage rates are endogenously determined and land input into production is considered. They attempted to obtain explicit results of comparative static analysis, but the generality of the model rendered determination of sign ambiguous in many cases: only the effect of a change in agriculture land rent is clearly

determined.

Recognizing the problem in Ross & Yinger [1995], the model presented in this chapter is simplified for obtaining explicit analysis results; that is, producers' production activity is neglected, and the wage rates in both employment centers are given exogenously and assumed to be the same. A subcenter is assumed to be established at a point in an Alonso-type monocentric city with an Anas & Moses-type transportation system. After a new employment center is formed, the city is divided into two sections: CBD-area (residential area for people who commute to CBD) and SBD-area (residential area for people who commute to SBD). According to subcenter location, the urban shape is different. Two main cases are discussed in detail and systematic comparative static analysis for each is performed. And the effects of subcenter location (that have not been examined previously) are also explored. From the results, it is found that the establishment of a subcenter does not change the effects of parameters in the basic monocentric city. As for the effects of subcenter location, it is shown that, in terms of the distance from CBD, creating a subcenter at a more distant location increases consumers' welfare, expands CBD-area and causes SBD-area to contract.

### Chapter 3 . Model of an Open City with a Subcenter

Following the framework in chapter two, we analyze the effects of subcenter formation on urban spatial structure in the setting of an open city. As in chapter two, two cases are considered and comparative static analysis for each is analyzed. On comparing the results with the monocentric city, it is shown that subcenter formation keeps all properties obtained in a monocentric city unchanged. As for the effects of subcenter location, it is shown that the population in the city increases when a subcenter is created at a more distant location. Since a subcenter is built in an existing Alonso-type monocentric city, the CBD-urban fringe (urban fringe corresponding to CBD-area) and the rent in CBD-area are not influenced by establishment of a subcenter; while a more distant subcenter location moves the SBD-urban fringe (urban fringe corresponding to SBD-area) outward. The effect of subcenter location on the rent in the SBD area is divided into two parts according to subcenter and residents' locations. In terms of the distance from CBD, if a residential location is closer than the subcenter, the bid rent at that location will be decreased by a more distant subcenter location. If residential location is further than the subcenter, the bid rent at that location will be increased when the subcenter is moved outward.

### Chapter 4 . Model of Edge City

Edge cities, as a new phenomenon of suburbanization, are booming in modern cities in North America, Europe and Asia. Unlike traditional suburbanization or urban sprawl, an edge city is developed by large-scale private developers or real-estate speculators and, as an independent city, supplies employment opportunities and services to its residents. On the other hand, as a counterpart of core city, the edge city also competes for land and labor so as to maximize its profit. On formation of an edge city, a large number of skilled laborers or specialists are attracted to concentrate there, so the edge city also presents a perspective on how segregation occurs by income or socio-economic class occurs.

By making comparisons with the work of Henderson & Mitra [1996] and Fujita, Thisse & Zenou [1997], we build an edge city model in which the developer is purely treated as an agent engaging in real-estate transaction. Unlike Henderson & Mitra [1996], both consumer and producer land demand are endogenously determined. Meanwhile, following the fact that labor forces has different skills in core city and edge city, we let wage rates in both cities be determined endogenously by introducing the approach of Sasaki & Kaiyama [1990] into the model. Because of the complexity of the system, results can only be numerically obtained by simulation.

## Chapter 5 . Retrospect and Prospect

In this paper, we built two kinds of duo-centric city model to explore the phenomenon of suburbanization and examine the effects of the process of suburbanization on urban spatial structure. In this chapter, some main conclusions are summarized. As a most important result, it is demonstrated that subcenter formation increases citizens' welfare in a closed city and increases population in an open city.

However, there still are some defects in the models. For example, in the duo-centric city model, the assumption of the same income level in both the CBD and the SBD areas should be relaxed since it is more realistic for CBD and SBD to have different wage rates.

Finally, we discuss some possible ways to develop the model further. As well as relaxing some strict assumptions, another feasible development would be to introduce the approach of dynamic model into present models. Since the process of suburbanization is not only a spatial process, but also a temporal process, both location and timing of land development should be simultaneously determined in the whole system.

## 審 査 結 果 の 要 旨

都市の成長に従い、中心業務地区に加えサブセンターが形成され、土地利用、地代、交通の量、方向などが単一中心都市の場合と異なり複雑になってくる。近年、サブセンターを組み込んだ都市システムの解明がなされつつあるが、本論文はサブセンターの形成が都市の空間構造に与える影響を理論的に分析した成果であり、全編5章よりなる。

第1章は序論であり、本研究の背景と目的が述べられ、関連する分野でのこれまでの文献が詳細に批判的にレビューされている。

第2章では「人口閉鎖型都市システム」(closed city system)のフレームワークの中で、交通体系、所得水準、人口規模などの環境の変化が住民の厚生、都市の大きさ、地代などの都市構造におよぼす比較静学分析を綿密に行っている。特に、サブセンターの立地点の都市構造に与える影響を理論的に明確に導出している。これはこの分野での最初の業績であり、きわめて大きな貢献である。

第3章では、「人口開放型都市システム」(open city system)での、比較静学分析を厳密に行っている。その結果、環境変数の影響の方向は、単一中心都市システムの場合と同一であることが示される。これは、都市システムのパフォーマンスを比較する上で貴重な知見である。特に、サブセンターの形成の効果に関する比較静学分析をこれまでの研究とは異なる独創的方法によって行っている。この方法は今後この分野で大いに応用されると期待される。

第4章では、都市の郊外化の最も新しいタイプである「エッジシティ・システム」(edge city system)について、その構造を決定するためのモデル構築がなされている。そこでは、これまでの研究では扱われなかった、家計の行動をも陽表的に導入した一般均衡体系のモデル化がなされており、この分野での今後の研究方向について重要な指針を与えている。

第5章は結論である。

以上要するに、本論文は、サブセンターの形成等による郊外化が都市システムに与える影響に関して綿密な理論的分析を行ったものであり、情報科学分野の発展に寄与するところが少なくない。よって本論文は博士(情報科学)の学位論文として合格と認める。